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PRECOOLING OF PREPACKAGED SWEET CORN WITH CRUSHED ICE

By

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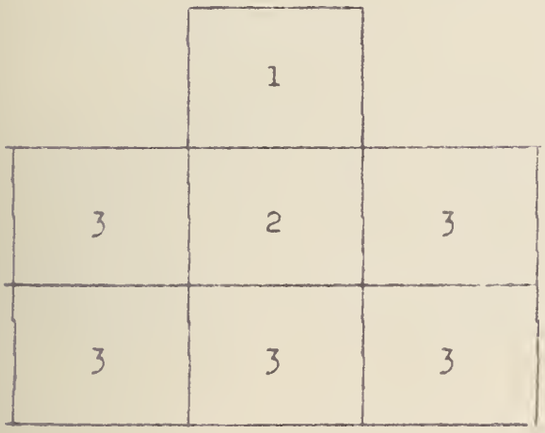
This is a report on three experiments so designed as to determine whether the use of package ice can be substituted for hydrocooling in removing field heat from sweet corn, particularly after it has been packaged in cellophane bags. If this method of precooling could be shown to be satisfactory it could well have application when corn is packaged near sources of supply where facilities for hydrocooling might not be readily available.

The tests were conducted August 27, September 3, and September 11, 1947, in cooperation with the Atlantic Commission Company at their Harborside plant in Jersey City, New Jersey. The corn was of New York origin. After husking and trimming, the ears were packaged four to a bag in moisture-proof cellophane (450 MSAT) spinach bags. The bags were heat sealed and packed in standard celery crates, two layers high, 24 bags per crate. The crates were first lined with parchment paper. Crushed ice was then added in the amount of 12 pounds per crate in the first test, and 24 pounds per crate in the other two tests, before the bags were placed in the crate. Holes were punched in the parchment paper lining at several points to permit escape of water from the melted ice. Thermocouples were inserted into the center of cobs in bags packed in various positions in the crates. The bags were then covered with parchment paper. Crushed ice in the amount of 36 pounds per crate in the first test, and 24 pounds in tests two and three was added on top of it, and the crate lidded. Two crates were so prepared in each test. One crate was placed on the other, and the lower one was surrounded by packaged-iced celery crates in the manner shown below.

Crate Arrangement



Legend

1. Exposed test crate of corn.

2. Buried test crate of corn, (i.e. completely surrounded by packages).

3. Packaged iced crates of celery. (The temperature of the produce surrounding the test packages averaged 54° and 55°F. in tests #2 and #3 respectively, and 65°F. in test #1.

Accompanying each test temperatures were also taken by means of thermocouples in three husked ears suspended in a tank of non-circulating ice water. This was to compare the rate of cooling in the packages with what might have been expected to occur with corn hydrocooled in ice water.

Temperatures of top and bottom layers in each crate are summarized in tables 1 to 3 and in figures 1 to 3-A. These represent the results of the three tests. Included in the tables is a comparison between hydrocooling of husked cobs and cooling of prepackaged sweet corn with crushed ice.

From these data it can be calculated that for the six record crates in the three tests there was an average drop of 27 degrees in four hours, or 6.75 degrees per hour from an initial average of 78° F. Considering the importance of low temperatures in reducing the transformation of sugar into starch in sweet corn, the drop is important. Appleman and Arthur 1/ have

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1/ Appleman, C. O., and Arthur, J. M.
1919. Carbohydrate metabolism in green sweet corn during storage at different temperatures. Jour. Agr. Research 17: 137-152.

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shown that in corn held at 86° F. fifty percent of the sugar was lost during the first twenty-four hours. At 68° the loss of sugar was twenty-five percent and at 50° the loss was about fifteen percent during the same period.

Lower temperatures were reached in approximately one hour with those cobs immersed in ice water. In tests No. 1 and No. 2 the temperature of the cobs approximated that of ice water in about an hour. In test No. 3 however, the temperature of the cobs did not reach the water temperature after an hour.

Figure 2-A demonstrates the importance of maintaining the cooling water at a low temperature. The cob temperature rises rapidly, as the water warms.

When facilities for a faster and a more desirable method of removing field heat from corn, such as hydrocooling, are not available substitution of package ice will lower the cob temperatures considerably, and is recommended. Through the temperatures reached in the present experiments are not as low as desired, they may be expected to prolong the marketable period of the corn. Further work needs to be done regarding the influence of such treatment on the quality of the corn through the marketing period.

Table 1

Summary of Sweet Corn Cooling Test No. 1
Temperatures (° F.) after different periods of cooling

	Length of Cooling Period in Minutes										Total Amount Cooling ° F	Cooling Per Hour ° F.
	Start	30	50	60	90	120	150	180	210	240		
Average cob temperatures in top layer bags of exposed iced crate.	82	70	64	62	57	56	52	52	50	49	33	8.25
Average cob temperatures in bottom layer bags of exposed iced crate.	81	79	77	74	71	69	65	63	61	58	23	5.75
Average cob temperatures in top layer bags of buried iced crate.	81	69	68	64	62	60	57	55	54	52	29	7.25
Average cob temperatures in bottom layer bags of buried iced crate.	80	78	78	75	73	71	66	64	61	59	21	5.25
Average cob temperatures all positions.	81	74	72	69	66	64	60	59	57	55	26	6.50
Air temperatures.	76	73	72	72	71	-	-	73	73	72		
Water temperature of ice bath.	-	43	34	33	-	33	33	33	33	33		
Average cob temperature of non-packaged ears immersed in ice water bath.	79	47	36	35	-	-	-	-	-	-		

Table 2

Summary of Sweet Corn Cooling Test No. 2
Temperatures (° F.) after different periods of cooling

	Length of Cooling Period in Minutes													Total Amount Cooling ° F.	Cooling Per Hour ° F.
	Start	15	30	45	60	75	90	105	120	150	180	210	240		
Average cob temperatures in top layer bags of exposed iced crate.	74	68	64	60	59	57	56	54	51	50	50	48	47	27	6.75
Average cob temperatures in bottom layer bags of exposed iced crate.	74	69	65	62	61	59	57	56	54	53	51	50	49	25	6.25
Average cob temperatures in top layer bags of buried iced crate.	76	74	71	71	69	68	66	65	63	61	59	58	56	20	5.00
Average cob temperatures in bottom layer bags of buried iced crate.	76	65	62	59	57	55	53	52	50	48	47	46	45	31	7.75
Average cob temperatures all positions.	75	69	65	63	62	60	58	57	55	53	52	51	49	26	6.50
Air temperatures.	75	77	73	82	79	79	79	77	78	79	77	79	77		
Water temperature of ice bath.	45	42	42	42	42	42	42	41	42	42	43	44	-		
Average cob temperature of non-packaged ears immersed in ice water bath.	74	63	52	47	44	42	40	41	42	44	45	-	-		

Table 3
Summary of Sweet Corn Cooling Test No. 3
Temperatures (° F.) after different periods of cooling

	Start	20	35	50	65	80	95	110	140	170	200	230	260	Cooling ° F.	Cooling Per Hour ° F.
Average cob temperatures in top layer bags of exposed iced crate.	79	67	64	63	61	60	59	58	55	54	52	51	50	29	6.70
Average cob temperatures in bottom layer bags of exposed iced crate.	79	65	65	63	62	62	61	60	57	56	56	55	54	25	5.77
Average cob temperatures in top layer bags of buried iced crate.	79	73	70	70	68	67	66	65	62	60	58	56	56	23	5.31
Average cob temperatures in bottom layer bags of buried iced crate.	79	60	58	57	55	54	53	52	50	49	47	46	45	34	7.85
Average cob temperatures all positions	79	66	64	63	62	61	60	59	56	55	53	52	51	28	6.46
Air temperatures.	79	77	79	79	79	79	80	80	80	77	77	77	76		
Water temperature of ice bath.	78	47	44	42	42	42	42	41	43	-	-	-	-		
Average cob temperature of non-packaged ears immersed in ice water bath.	79	65	56	51	48	46	46	47	51	54	-	-	-		

Figure 1. Rate of cooling of packaged sweet corn. (Test 1).
Average cob temperatures in top layer and bottom layer cellophane bags of exposed and buried iced crates.

Figure 1-A. Comparative rate of cooling of husked sweet corn in (1) ice water and (2) in cellophane bags packed in iced crates. (Test 1)

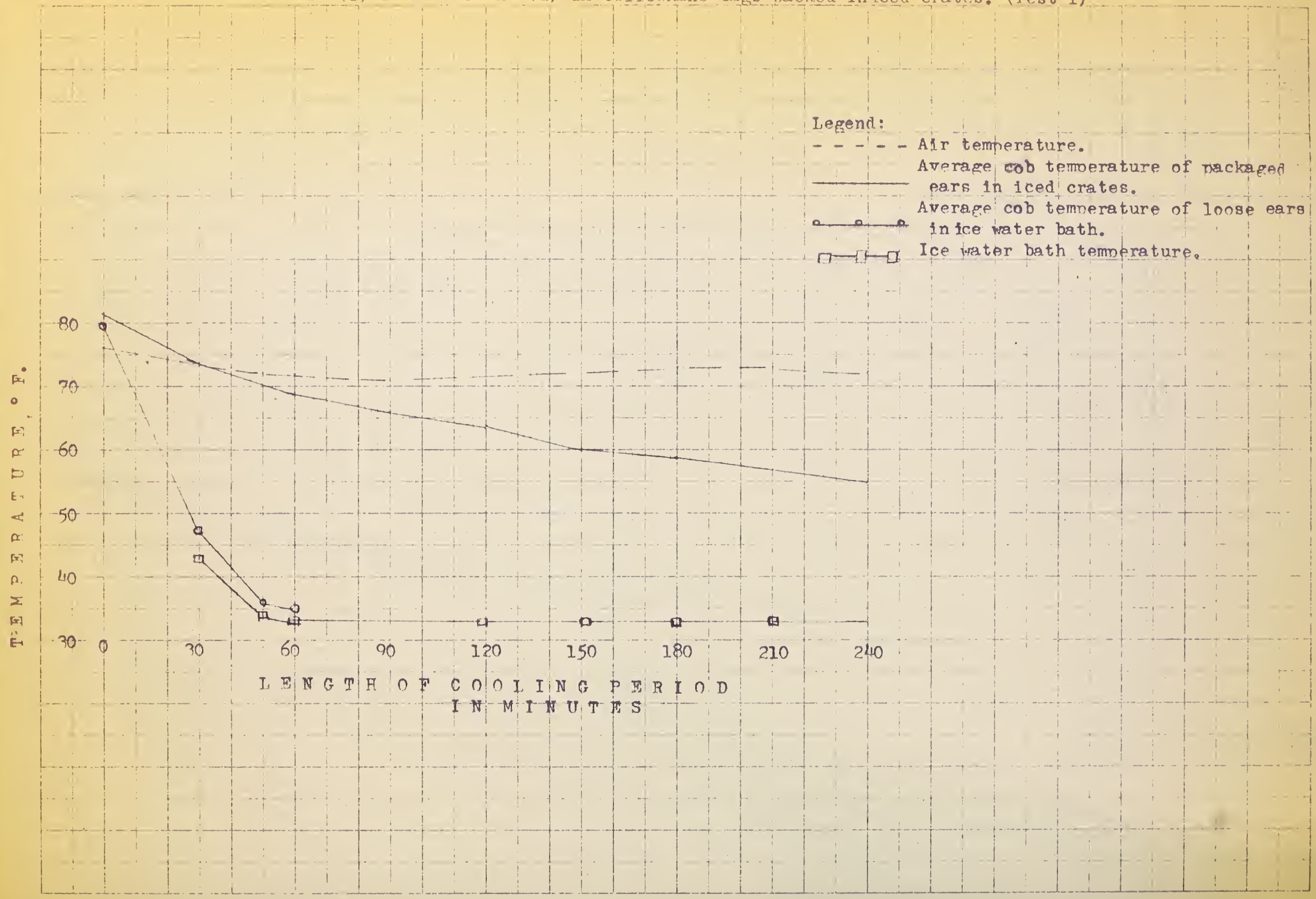

Figure 2. Rate of cooling of packaged sweet corn. (Test 2)

Average cob temperatures in top layer and bottom layer cellophane bags of exposed and buried iced crates.

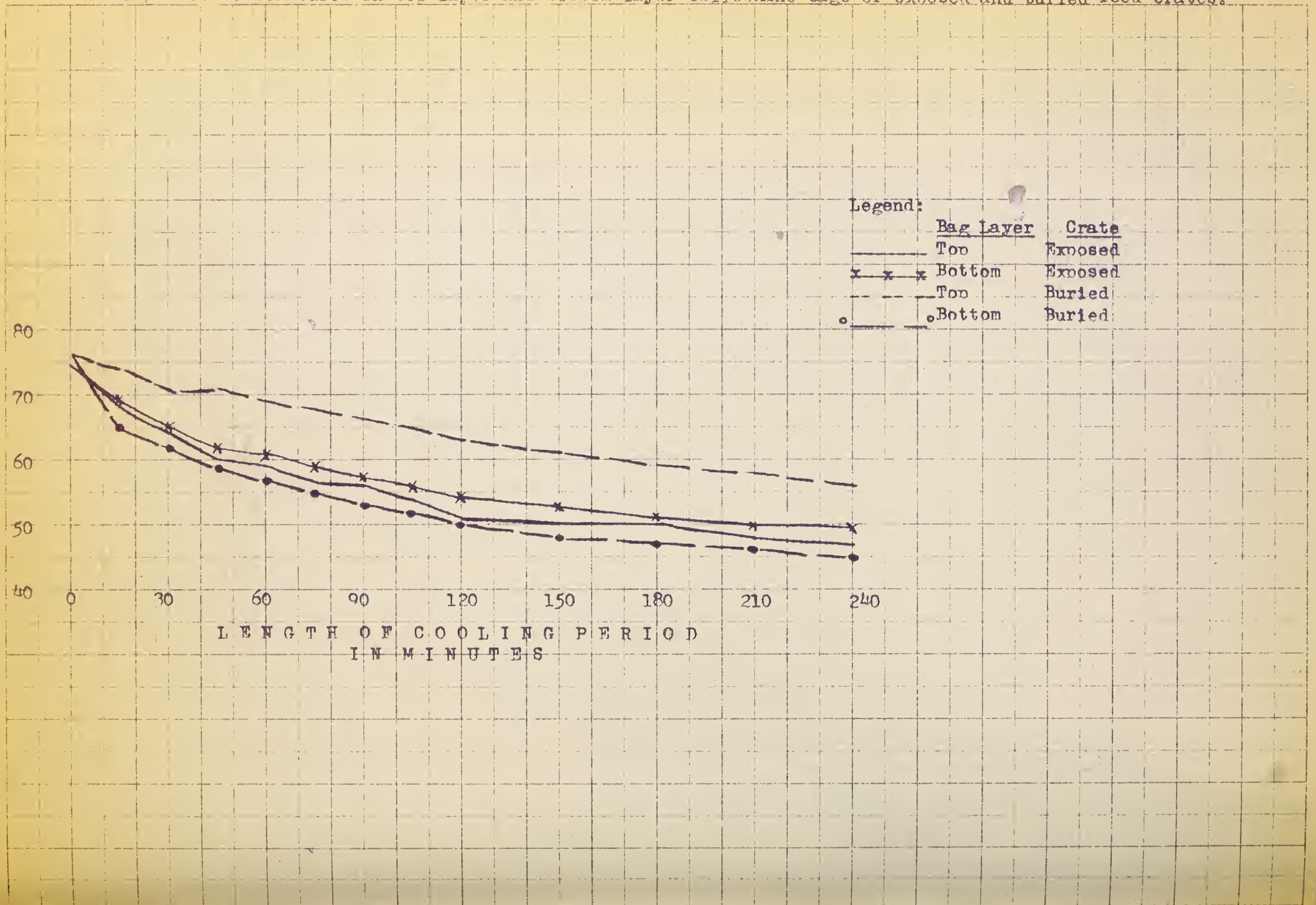

Figure 2-A. Comparative rate of cooling of husked sweet corn in (1) ice water and (2) in cellophane bags packed in iced crates (Test 2).

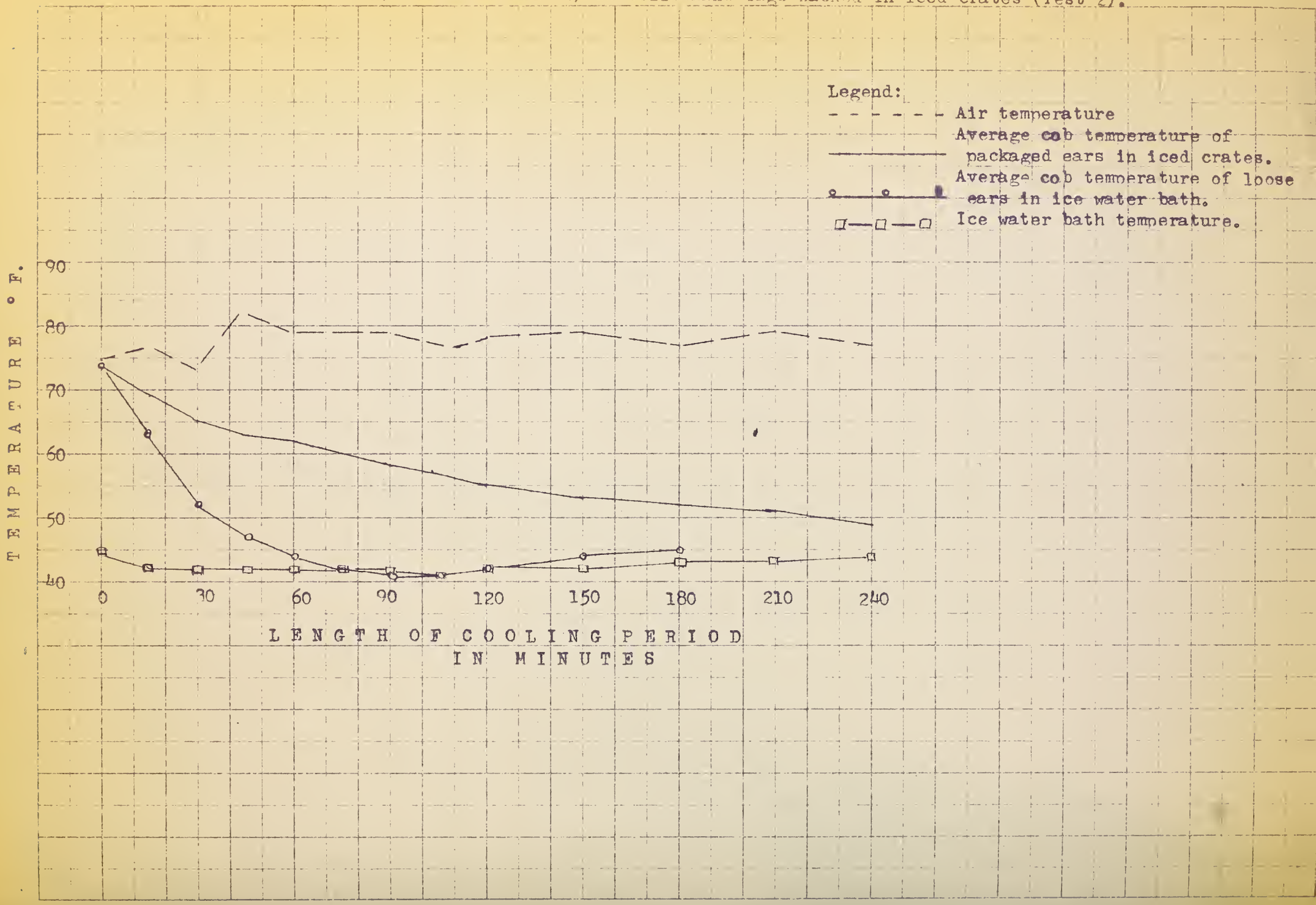

Figure 3. Rate of cooling of packaged sweet corn. (Test 3)
Average cob temperatures in top layer and bottom layer cellophane bags of exposed and buried iced crates.

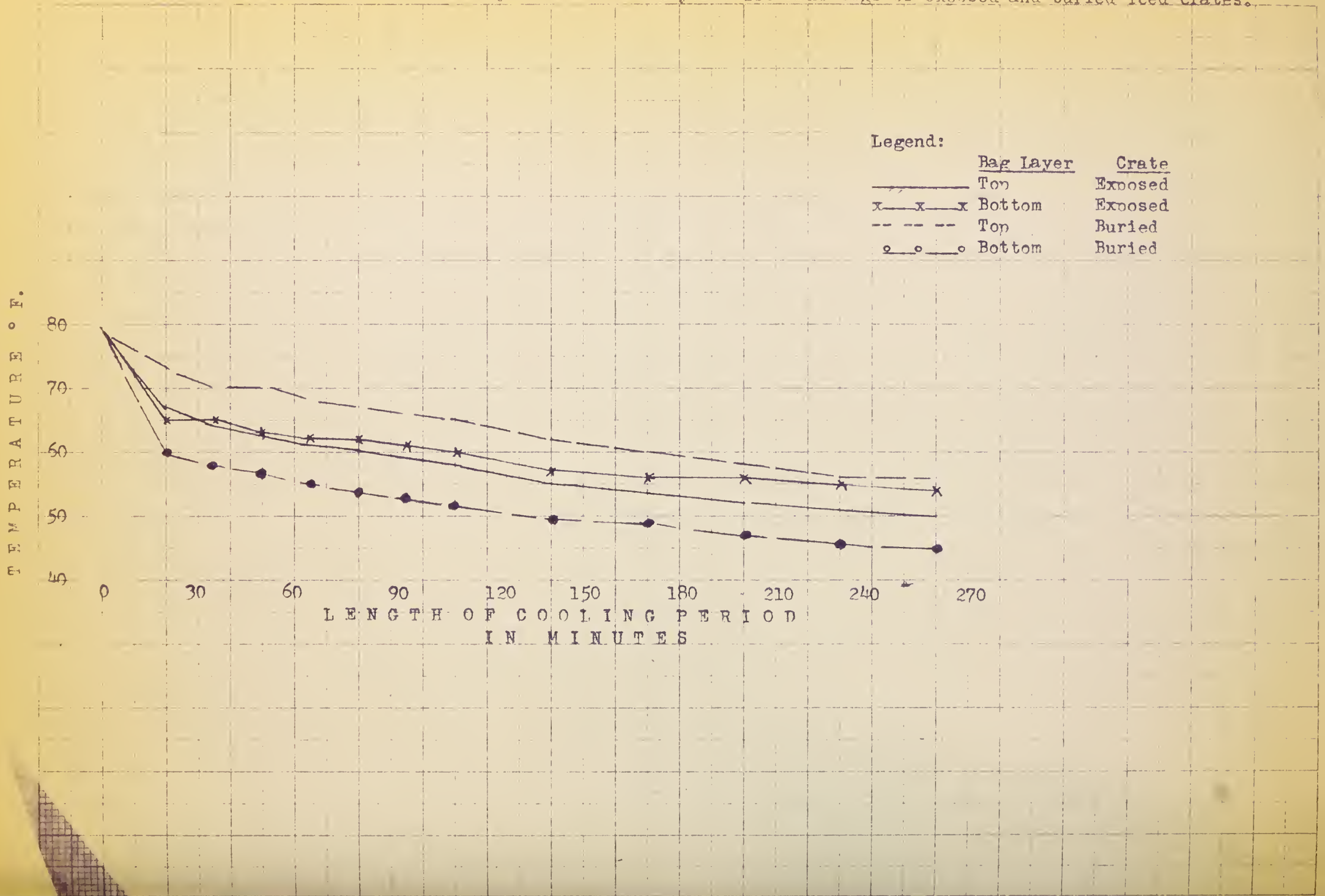

Figure 3-A. Comparative rate of cooling of husked sweet corn in (1) ice water and (2) in cellophane bags packed in iced crates (Test 3)